



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/091,106	03/05/2002	John Commander	CEDE 2036	5919

321 7590 08/10/2005

SENNIGER POWERS LEAVITT AND ROEDEL
ONE METROPOLITAN SQUARE
16TH FLOOR
ST LOUIS, MO 63102

EXAMINER

WONG, EDNA

ART UNIT PAPER NUMBER

1753

DATE MAILED: 08/10/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/091,106

Applicant(s)

COMMANDER ET AL.

Examiner

Edna Wong

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 July 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-7, 17, 31 and 43 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7, 17, 31 and 43 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

This is in response to the Amendment dated July 27, 2005. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Response to Arguments

Claim Rejections - 35 USC § 112

Claims **14, 54-59 and 62** have been rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The rejection of claims 14, 54-59 and 62 under 35 U.S.C. 112, first paragraph, has been withdrawn in view of Applicants' amendment. Claims 14, 54-59 and 62 have been cancelled.

Claim Rejections - 35 USC § 103

Claims **14 and 54-59** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Barstad et al.** (US Patent No. 6,444,110 B2).

The rejection of claims 14 and 54-59 under 35 U.S.C. 103(a) as being unpatentable over Barstad et al. has been withdrawn in view of Applicants' amendment. Claims 14 and 54-59 have been cancelled.

Allowable Subject Matter

The indicated allowability of claims **1-7, 17, 31 and 43** is withdrawn in view of the newly discovered reference(s) to **Creutz, deceased et al.** (US Patent No. 4,110,176).

Rejections based on the newly cited reference(s) follow.

Response to Amendment

Claim Rejections - 35 USC § 112

Claims **1-7 and 31** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1

line 13, it appears that the "superfilling" is further limiting the "fill" recited in claim 1, line 12. However, it is unclear if it is. If it is not, then what is the relationship between the superfill and the fill?

line 15, "the wafer" lacks antecedent basis.

Claim 31

lines 9-10, "the wafer" lacks antecedent basis.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Concentrate

I. Claim **31** is rejected under 35 U.S.C. 102(b) as being anticipated by **Creutz, deceased et al.** (US Patent No. 4,110,176).

Creutz teaches a concentrate comprising:

(a) copper ions (col. 1, lines 38-54); and

(b) a defect reducing agent, wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine (= N-(2-hydroxyethyl) polyethylenimine and benzyl chloride) [col. 3, line 67 to col. 4, line 14].

As to the claim limitations of:

(i) “for preparation of a copper electroplating bath for electroplating a copper deposit onto a semiconductor integrated circuit device substrate having electrical interconnect features including submicron-sized features such that the surface has submicron-sized reliefs therein”; and

(ii) “which reduces the occurrence of protrusion defects from superfilling, surface roughness, and voiding due to uneven growth, and improves macro-scale planarity

across the wafer, wherein the defect reducing agent reduces a rate of recrystallization and grain growth in copper deposited using said copper electroplating bath, thereby reducing the formation of internal voids in the deposited copper”,

these limitations do not compositionally distinguish the concentrate from the prior art.

II. Claim 43 is rejected under 35 U.S.C. 102(b) as being anticipated by **Creutz, deceased et al.** (US Patent No. 4,110,176).

Creutz teaches a concentrate comprising:

(a) copper ions (col. 1, lines 38-54); and

(b) a defect reducing agent, wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine (= N-(2-hydroxyethyl) polyethylenimine and benzyl chloride) [col. 3, line 67 to col. 4, line 14].

As to the claim limitations of:

(i) “for preparation of a copper electroplating bath for electroplating a copper deposit onto a semiconductor integrated circuit device substrate having electrical interconnect features including submicron-sized features such that the surface has submicron-sized reliefs therein”; and

(ii) “which yields a copper deposit having an overall surface which is more level than a comparable overall surface electroplated without the defect reducing agent”,

these limitations do not compositionally distinguish the concentrate from the prior art.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Method

I. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Barstad et al.** (US Patent No. 6,444,110 B2) in combination with **Creutz, deceased et al.** (US Patent No. 4,110,176).

Barstad teaches a method for electroplating a copper deposit onto a semiconductor integrated circuit device substrate (= semiconductor integrated circuits) [col. 3, lines 55-56] having electrical interconnect features including submicron-sized features such that the surface has submicron-sized reliefs therein (col. 2, lines 50-52; and col. 7, line 66 to col. 8, line 7), the method comprising:

(a) immersing the semiconductor integrated circuit device substrate into an electroplating bath including ionic copper (col. 4, lines 7-19) and an effective amount of a defect reducing agent (= a brightener, suppressor, or leveling agent) [col. 5, lines 3-67; col. 6, lines 23-58; and col. 6, line 63 to col. 7, line 19]; and

(b) electroplating the copper deposit from said bath onto the substrate to fill the submicron-sized reliefs whereby the occurrence of protrusion defects from superfilling, surface roughness, and voiding due to uneven growth are reduced, and macro-scale planarity across the wafer is improved (= effectively copper plated with no defects (e.g., no voids, inclusions by ion beam examination)) [col. 7, line 46 to col. 8, line 7; and col. 8, lines 38-40 and lines 65-67].

The defect reducing agent improves distribution of deposited copper over the substrate surface (= leveling agent) [col. 6, line 63 to col. 7, line 19].

The method of Barstad differs from the instant invention because Barstad does not disclose the following:

- a. Wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine, as recited in claim 1.
- b. Wherein the defect reducing agent reduces high current density edge effect during electroplating, as recited in claim 2.
- c. Wherein the deposit has a deposit thickness of about 1 micron and which varies by no more than about 0.2 microns across the deposit, the deposit thickness being measured from an upper surface of the deposit to the substrate surface at its thickest point, as recited in claim 4.
- d. Wherein the defect reducing agent facilitates deposition of a thinner overall deposit to achieve a minimum thickness across the substrate than an overall

deposit required to achieve such minimum thickness by electroplating without said defect reducing agent, as recited in claim 5.

e. Removing a portion of the copper deposit by chemical and mechanical action to yield a level substrate, wherein an amount of copper deposit to be removed is less than an amount of copper deposit which must be removed by chemical and mechanical action to yield a level substrate in a comparable substrate electroplated without said defect reducing agent, as recited in claim 6.

f. Wherein pitting corrosion from said chemical action is less severe than pitting corrosion in the comparable substrate electroplated without said defect reducing agent, as recited in claim 7.

Regarding claim 1, like Barstad, Creutz teaches a copper electroplating composition. Creutz teaches that N-(2-hydroxyethyl) polyethylenimine and benzyl chloride is a brightening agent (col. 3, line 67 to col. 4, line 14).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the copper electroplating bath described by Barstad by using N-(2-hydroxyethyl) polyethylenimine and benzyl chloride as a brightening agent because Barstad teaches that a wide variety of brighteners, including known brightener agents, may be employed in the copper electroplating compositions of his invention (col. 5, lines 3-5). The N-(2-hydroxyethyl) polyethylenimine and benzyl chloride is a known brightener agent as taught by Creutz (col. 3, line 67 to col. 4, line

14), and thus, would have been suitable in the copper electroplating compositions disclosed by Barstad.

Furthermore, it has been held that the selection of a known material based on its suitability for its intended use supports a prima facie obviousness determination. See MPEP § 2144.06 and § 2144.07.

Regarding claim 2, like Barstad, Creutz teaches a copper electroplating composition. Creutz teaches that N-(2-hydroxyethyl) polyethylenimine and benzyl chloride is a brightening agent (col. 3, line 67 to col. 4, line 14).

As to wherein the defect reducing agent reduces high current density edge effect during electroplating, it has been held that a newly discovered use or function of components does not necessarily mean the system is unobvious since this use or function may be inherent in the prior art. *Ex parte Pfeiffer* 135 USPQ 31.

Regarding claim 4, wherein the deposit has a deposit thickness of about 1 micron and which varies by no more than about 0.2 microns across the deposit, the thickness of the deposit is well within the skill of the artisan to determine dependent upon the intended use of the device (e.g., for a printed circuit board vs. for a semiconductor wafer), particularly to the environment to which the device will encounter, which would be most suited for the application of the device, absent evidence to the contrary.

As to the deposit thickness being measured from an upper surface of the deposit

to the substrate surface at its thickest point, if the deposit thickness varies by no more than about 0.2 microns across the deposit, then measuring the deposit thickness at its thickest point would have revealed this, and that any other point beyond this would have been outside this range.

Regarding claim 5, like Barstad, Creutz teaches a copper electroplating composition. Creutz teaches that N-(2-hydroxyethyl) polyethylenimine and benzyl chloride is a brightening agent (col. 3, line 67 to col. 4, line 14).

As to wherein the defect reducing agent facilitates deposition of a thinner overall deposit to achieve a minimum thickness across the substrate than an overall deposit required achieve such minimum thickness by electroplating without said defect reducing agent, it has been held that a newly discovered use or function of components does not necessarily mean the system is unobvious since this use or function may be inherent in the prior art. *Ex parte Pfeiffer* 135 USPQ 31.

Regarding claim 6, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Barstad by removing a portion of the copper deposit by chemical and mechanical action to yield a level substrate, wherein an amount of copper deposit to be removed is less than an amount of copper deposit which must be removed by chemical and mechanical action to yield a level substrate in a comparable substrate electroplated without said

defect reducing agent, Barstad discloses a method at least in a similar manner as instantly claimed. Therefore, one having ordinary skill in the art would have expected that a portion of the copper deposit removed by chemical and mechanical action to yield a level substrate, wherein an amount of copper deposit to be removed would have been less than an amount of copper deposit which must be removed by chemical and mechanical action to yield a level substrate in a comparable substrate electroplated without said defect reducing agent.

Similar processes can reasonably be expected to yield similar results.

Chemical mechanical polishing (CMP) is conventional in the copper electroplating art to remove a portion of a copper deposit.

Regarding claim 7, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because Barstad appears to disclose a method at least in a similar manner as instantly claimed. Therefore, one having ordinary skill in the art would have expected that the pitting corrosion from said chemical action would have been less severe than pitting corrosion in the comparable substrate electroplated without said defect reducing agent.

Similar processes can reasonably be expected to yield similar results.

II. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Barstad et al.** (US Patent No. 6,444,110 B2) in combination with **Creutz, deceased et al.** (US

Patent No. 4,110,176).

Barstad teaches a method for electroplating a copper deposit onto a semiconductor integrated circuit device substrate (= semiconductor integrated circuits) [col. 3, lines 55-56] having electrical interconnect features including submicron-sized features such that the surface has submicron-sized reliefs therein (col. 2, lines 50-52; and col. 7, line 66 to col. 8, line 7), the method comprising:

(a) immersing the semiconductor integrated circuit device substrate into an electroplating bath including ionic copper (col. 4, lines 7-19) and an effective amount of a defect reducing agent (= a brightener, suppressor, or leveling agent) which reduces the formation of internal voids within the copper deposit (= effectively copper plated with no defects (e.g., no voids, inclusions by ion beam examination)) [col. 5, lines 3-67; col. 6, lines 23-58; col. 6, line 63 to col. 7, line 19; col. 7, line 46 to col. 8, line 7; and col. 8, lines 38-40 and lines 65-67]; and

(b) electroplating the copper deposit from said bath onto the substrate to fill the submicron-sized reliefs which deposit is characterized by a reduced concentration of internal voids (= effectively copper plated with no defects (e.g., no voids, inclusions by ion beam examination)) [col. 7, line 46 to col. 8, line 7; and col. 8, lines 38-40 and lines 65-67].

The method of Barstad differs from the instant invention because Barstad does not disclose the following:

- a. Wherein the defect reducing agent is a reaction product of benzyl chloride and hydroxyethyl polyethylenimine, as recited in claim 17.
- b. Wherein the defect reducing agent reduces a rate of recrystallization and grain growth in the copper deposit, as recited in claim 17.
- c. Wherein the deposit subsequently undergoes recrystallization and grain growth at a reduced rate, as recited in claim 17.

Regarding claim 17, like Barstad, Creutz teaches a copper electroplating composition. Creutz teaches that N-(2-hydroxyethyl) polyethylenimine and benzyl chloride is a brightening agent (col. 3, line 67 to col. 4, line 14).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the copper electroplating bath described by Barstad by using N-(2-hydroxyethyl) polyethylenimine and benzyl chloride as a brightening agent because Barstad teaches that a wide variety of brighteners, including known brightener agents, may be employed in the copper electroplating compositions of his invention (col. 5, lines 3-5). The N-(2-hydroxyethyl) polyethylenimine and benzyl chloride is a known brightening agent as taught by Creutz (col. 3, line 67 to col. 4, line 14), and thus, would have been suitable in the copper electroplating compositions disclosed by Barstad.

Furthermore, it has been held that the selection of a known material based on its suitability for its intended use supports a prima facie obviousness determination. See

MPEP § 2144.06 and § 2144.07.

Regarding claim 17, like Barstad, Creutz teaches a copper electroplating composition. Creutz teaches that N-(2-hydroxyethyl) polyethylenimine and benzyl chloride is a brightening agent (col. 3, line 67 to col. 4, line 14).

As to wherein the defect reducing agent reduces a rate of recrystallization and grain growth in the copper deposit, it has been held that a newly discovered use or function of components does not necessarily mean the system is unobvious since this use or function may be inherent in the prior art. *Ex parte Pfeiffer* 135 USPQ 31.

Regarding claim 17, the invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because Barstad appears to disclose a method at least in a similar manner as instantly claimed. Therefore, one having ordinary skill in the art would have expected that the deposit would have subsequently undergone recrystallization and grain growth at a reduced rate.

Similar processes can reasonably be expected to yield similar results.

Citations

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

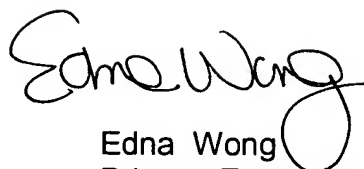
Barbieri et al. (US Patent No. 4,555,315) is cited to teach a copper electroplating bath comprising a bath soluble reaction product of polyethyleneimine and benzyl chloride (col. 4, lines 33-40).

Creutz (US Patent No. 3,770,598) is cited to teach a copper electroplating bath comprising a reaction product of polyethyleneimine and benzyl chloride (col. 5, Example 1).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Edna Wong
Primary Examiner
Art Unit 1753

EW
August 5, 2005